

The variation of the lower anterior facial height and its component parameters among the three over bite relationships (Cephalometric study)

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ABSTRACT

Aims: To evaluate the genders and over bite subjects group variation for the lower anterior facial height (LAFH) and its component parameters in Iraqi population in Mosul City. **Materials and Methods:** The study was performed by using measurements on pretreatment cephalometric radiographs of 79 patients, 27 with normal over bite and 26 for each open and deep over bite. The age ranged from 12-16 years with Class I dentoskeletal relationship. **Results:** The normal over bite group was significantly larger maxillary anterior alveolar ratio and the mandibular anterior and basal height in male when compared with female. Deep bite group appeared significantly larger mandibular anterior alveolar depth in males than in females. The open bite group showed significantly larger interincisal angle in females than in males. Multiple range variation analysis of the lower facial height and its component parameters disclosed no significant differences in these parameters among the over bite groups except that the open bite group was significantly larger mean value in the LAFH and significantly lower mean value in the interincisal angle when compared with normal and deep bite groups. **Conclusion:** The significant gender variation of the LAFH and its components of the normal over bite group were appeared in maxillary anterior alveolar depth, ratio and mandibular anterior alveolar height; whereas in deep bite group appeared in mandibular anterior alveolar depth, and in open bite group demonstrated in the interincisal angle.

Key Words: Facial height, alveolar height, alveolar depth, basal-alveolar ratio.

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INTRODUCTION

The lower anterior facial height (LAFH) is defined as the vertical distance between the anterior nasal spine and the menton points.^(1, 2) Obviously this distance is potentially affected by the more increment or reduction through the compensatory growth pattern of the basoalveolar bone, and the dental eruption. The divergent growth pattern of the facial bones permits the vertical growth of the dentoalveolar components.⁽³⁾

The anterior vertical disturbances can be described as anterior open bite or deep bite. Open bite could be due to normal eruption of posterior teeth associated with incomplete eruption of the anterior teeth, excessive eruption of posterior teeth accompanied with normal eruption of anterior teeth

(the mandible rotates downward and backward). This facial pattern is called long face. The reverse is true in deep bite; in this circumstance, the incisor teeth erupt normally but the insufficient eruption of the posterior teeth associated with upward forward rotation of the mandible. This facial pattern is called short face. Correcting an accompanying deep bite or open bite may require an alteration in the vertical position of the posterior teeth, so the mandible can rotate to more normal inclination.⁽⁴⁾ The orthodontic movement of teeth takes place in the alveolar bone of both maxilla and mandible and fails to involve the basal bone.⁽⁵⁾ Cephalometric analysis is required for evaluation of patient with vertical problems for a goal of accurately corrections of skeletal and dental relations.⁽⁴⁾ Adams

and Kerr⁽⁶⁾ found significant negative correlation between the lower face height and the over bite. This finding was supported with that of Dung and Smith,⁽⁷⁾ while Fleming⁽⁸⁾ reported that there was a significant positive correlation between the over bite and dentoalveolar height.

It was reported that there were a significant difference between patients with normal and deep bites in the dentoalveolar region of maxilla.^(9, 10) Deep bite subjects were associated with smaller lower facial height and a more widened shape of the symphysis.⁽¹¹⁾

The open bite subjects were showed significantly smaller maxillary and mandibular alveolar and basal cross-section area compared with normal over bite or the deep bite.⁽¹¹⁾

The vertical variation of the over bite probably coincides with a relative hyperdevelopment or hypodevelopment of the symphysis.⁽¹²⁾

A certain relationship may exist between the structure of the anterior part of the maxilla and the mandible and the LAFH for the anterior over bite relationships in Iraqi subjects.

This study was planned to evaluate the variation of the LAFH and its components among the three types of anterior overbite in Class I dentoskeletal relationships in Iraqi adolescents who live in Mosul City.

MATERIALS AND METHODS

The sample comprised of 79 lateral cephalometric radiographs for each gender of age 12–16 years for the Iraqi patients live in Mosul City, who were not treated orthodontically. They were attended the Department of Pedodontics, Orthodontics and Preventive Dentistry, College of Dentistry, University of Mosul.

The criteria of the selected sample subjects were Class I molar and skeletal relationships (The ANB angle of the lateral cephalometric of the subject was zero to 2 degrees), normal bite 1–4 mm⁽¹³⁾ (13 males and 14 females), open bite less than 1 mm (15 males and 11 females) and deep bite more than 4 mm (13 for each gender).

The lateral cephalometric radiographs of the sample subjects were traced and de-

finied the ANB angle according to Stien-er,^(14, 15) the LAFH (ANS–Me) as defined by Wylie⁽¹⁾ and Bjork,⁽¹⁶⁾ the interincisal (IIA) angle as defined by Downs^(17, 18) and Stien-er,⁽¹⁹⁾ the maxillary anterior alveolar and basal height (MxAABH), the mandibular anterior alveolar and basal height (MdAABH), the maxillary anterior alveolar depth (MxAAD), the mandibular anterior alveolar depth (MdAAD), the ratio of the MxAAD/MxAABH and the ratio of the MdAAD/MdAABH as defined by Reilo *et al.*⁽⁹⁾ (Figure 1). The LAFH and the component parameters of the lower anterior height were measured and recorded for the three types of over bites.

The results were analyzed and included the descriptive analysis: Mean values, standard deviation, standard error, maximum and minimum values; the Student's *t*-test at 0.05 significant level to reveal the gender variation of these parameters and applying the analysis of variance (AN-OVA) and Duncan's Multiple Range Test analyses at 0.05 significant level to evaluate the variation of these parameters among the groups.

RESULTS

The descriptive and gender variation analyses of the LAFH and its component parameters for the three types of the overbite groups were presented in Tables (1), (2) and (3).

The open bite group showed higher mean value than the normal and deep bite groups in the following parameters: LAFH, and MdAABH, meanwhile showed the lower mean value in the IIA angle, MxAABH, maxillary anterior alveolar ratio (MxAAR), MdAAD, mandibular anterior alveolar ratio (MdAAR) parameters for both genders and MxAAD in male.

The deep bite subject group revealed greater mean value than the normal over bite group in the IIA, MxAABH and MdAAD parameters for both genders and MdAAR parameter for males, whereas in (MxAAD), (MxAAR) and (MdAABH) parameters for females. The deep bite also appeared lower mean value than normal overbite group in the LAFH for both genders and MxAAD, MxAAR and MdAABH for males, whereas MdAAR for females.

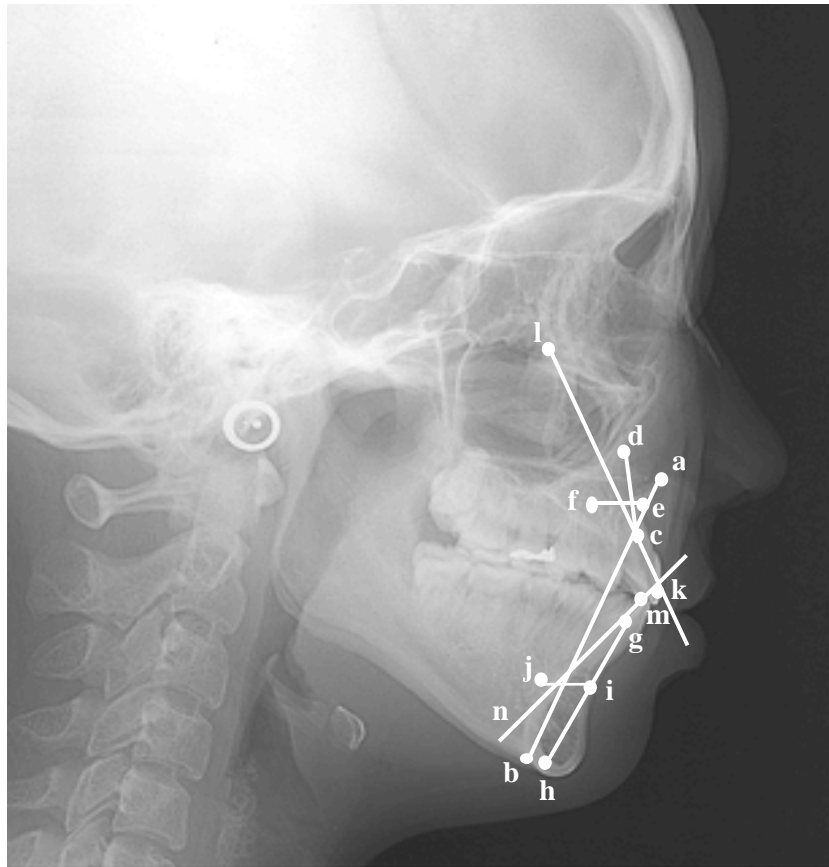


Figure (1): The lower facial height and its component parameters
 a–b: Lower facial height; c–d: Maxillary anterior alveolar basal height; e–f: Maxillary anterior alveolar depth; g–h: Mandibular anterior alveolar basal height; i–j: Mandibular anterior alveolar depth; kl–mn: Interincisal angle.

Table (1): Descriptive and gender's variation analyses of the anterior facial height and its component parameters in normal bite group

Variables***	Sex*	Mean Value	± SD	Minimum Value	Maximum Value	t-value	Sig.**
Lower Anterior Facial Height	M	72.04	4.81	65	79.5	1.66	NS
	F	69.18	4.15	62	74.5		
Interincisal Angle	M	124.77	7.77	113	138.5	-0.20	NS
	F	125.50	10.10	110	147		
Maxillary Anterior Alveolar and Basal Height	M	21.50	1.38	19	24	1.27	NS
	F	20.68	1.92	18.5	24		
Maxillary Anterior Alveolar Depth	M	18.65	5.76	11	30	3.26	S
	F	13.00	2.90	9	19.5		
Maxillary Anterior Alveolar Ratio	M	0.869	0.255	0.458	1.276	2.95	S
	F	0.633	0.152	0.391	1.000		
Mandibular Anterior Alveolar and Basal Height	M	33.92	3.66	27	40	2.46	S
	F	31.00	2.45	27	35		
Mandibular Anterior Alveolar Depth	M	10.77	2.11	8.5	15	1.73	NS
	F	9.32	2.22	6.5	14		
Mandibular Anterior Alveolar Ratio	M	0.324	0.094	0.225	0.537	0.56	NS
	F	0.304	0.089	0.191	0.509		

SD: Standard deviation.

* M= Male (n= 13); F= Female (n= 14).

** Sig.: Significance; NS= Not significant ($p > 0.05$); S= Significant ($p \leq 0.05$).

*** All variables were in millimeter except IIA in degrees.

Table (2): Descriptive and gender's variation analyses of the anterior facial height and its component parameters in deep bite group

Variables***	Sex	Mean Value	± SD	Minimum Value	Maximum Value	t-value	Sig.**
Lower Anterior Facial Height	M	69.69	3.76	62	77	0.58	NS
	F	68.69	5.13	60	76		
Interincisal Angle	M	130.58	7.91	118	144	-0.05	NS
	F	130.80	10.7	106.5	147		
Maxillary Anterior Alveolar and Basal Height	M	22.42	2.67	19.5	27.5	0.42	NS
	F	22.00	2.52	17.5	25.5		
Maxillary Anterior Alveolar Depth	M	18.46	4.41	11	25.5	0.88	NS
	F	16.69	5.78	9	29		
Maxillary Anterior Alveolar Ratio	M	0.835	0.219	0.458	1.133	0.58	NS
	F	0.776	0.298	0.391	1.277		
Mandibular Anterior Alveolar and Basal Height	M	33.62	2.23	31	38	0.89	NS
	F	32.81	2.40	29	36		
Mandibular Anterior Alveolar Depth	M	11.62	2.03	7	15.5	2.20	S
	F	9.77	2.23	5.5	12.5		
Mandibular Anterior Alveolar Ratio	M	0.347	0.069	0.2000	0.484	1.80	NS
	F	0.299	0.068	0.157	0.396		

SD: Standard deviation; * M= Male (n= 13); F= Female (n= 14).

** Sig.: Significance; NS= Not significant ($p > 0.05$); S= Significant ($p \leq 0.05$).

*** All variables were in millimeter except interincisal angle in degrees.

Table (3): Descriptive and gender's variation analyses of the anterior facial height and its component parameters in open bite group

Variables***	Sex*	Mean Value	± SD	Minimum Value	Maximum Value	t-value	Sig.**
Lower Anterior Facial Height	M	74.93	4.26	67.5	80	-0.06	NS
	F	75.05	5.33	66.5	82		
Interincisal Angle	M	114.07	7.24	102	124	-2.52	S
	F	123.4	11.50	104	139.5		
Maxillary Anterior Alveolar and Basal Height	M	22.40	3.31	18.5	28.5	0.47	NS
	F	21.86	2.04	19	24.5		
Maxillary Anterior Alveolar Depth	M	16.10	4.15	9.5	25.5	1.66	NS
	F	13.50	3.61	10	23		
Maxillary Anterior Alveolar Ratio	M	0.732	0.213	0.440	1.159	1.48	NS
	F	0.620	0.156	0.416	0.978		
Mandibular Anterior Alveolar and Basal Height	M	34.20	2.26	30	37	0.02	NS
	F	34.18	2.19	30.5	37		
Mandibular Anterior Alveolar Depth	M	9.83	1.44	6.5	12	1.07	NS
	F	9.05	2.31	4	13		
Mandibular Anterior Alveolar Ratio	M	0.290	0.054	0.180	0.366	1.00	NS
	F	0.265	0.069	0.111	0.393		

SD: Standard deviation; * M= Male (n= 13); F= Female (n= 14).

** Sig.: Significance; NS= Not significant ($p > 0.05$); S= Significant ($p \leq 0.05$).

*** All variables were in millimeter except interincisal angle in degrees.

The genders variation (ANOVA and Duncan's analyses) for the LAFH and its component parameters were appeared that the normal over bite group was significantly increase mean value ($p \leq 0.05$) in male than female in the MxAAD, MxAAR and

MdAABH parameters. The open bite group demonstrated significantly higher mean value ($p \leq 0.05$) in female than male in the IIA parameter only. The deep bite groups showed significantly greater mean value ($p \leq 0.05$) in male than female in the MdA-

AD parameter only.

The over bite groups variation (ANOVA and Duncan analyses) for the mean value (total male and female mean value) of the LAFH and its component parameters at $p \leq 0.05$ significant level presented in Table (4) and Figure (2) and (3). All the

parameters displayed no significant difference ($p > 0.05$) except that the open bite group which disclosed significantly greater mean value ($p \leq 0.05$) in the LAFH, and it was significantly lower mean value ($p \leq 0.05$) in the IIA angle when compared with normal and deep bite groups.

Table (4): Multiple range variation of the LAFH and its component parameters among the three type of over bite

Variables*	Normal Bite Group n= 27		Deep Bite Group n= 26		Open Bite Group n= 26	
	Mean	± SD	Mean	± SD	Mean	± SD
Lower Anterior Facial Height	70.556 ^a	4.192	69.102 ^a	4.434	74.981 ^b	4.640
Interincisal Angle	125.13 ^b	8.86	130.67 ^b	9.19	118.00 ^a	10.23
Maxillary Anterior Alveolar and Basal Height	21.074 ^a	1.702	22.212 ^a	2.554	22.173 ^a	2.807
Maxillary Anterior Alveolar Depth	15.722 ^a	5.276	17.577 ^a	5.118	15.000 ^a	4.072
Maxillary Anterior Alveolar Ratio	0.314 ^a	0.090	0.323 ^a	0.072	0.279 ^a	0.061
Mandibular Anterior Alveolar and Basal Height	32.407 ^a	3.374	33.212 ^a	2.307	34.192 ^a	2.187
Mandibular Anterior Alveolar Depth	10.019 ^a	2.251	10.692 ^a	2.294	9.500 ^a	1.855
Mandibular Anterior Alveolar Ratio	0.746 ^a	0.236	0.805 ^a	0.258	0.684 ^a	0.195

Different letters mean significant difference at 0.05 level.

Same letters mean no significant difference at 0.05 level.

*All variables were in millimeter except interincisal angle in degrees.

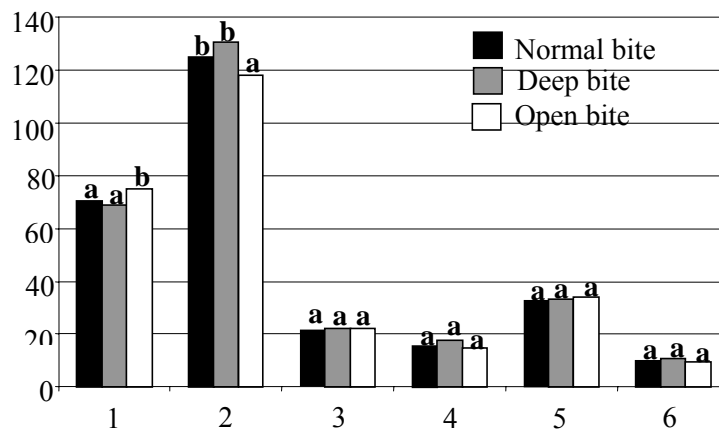


Figure (2): The differences in the values of the LAFH's component parameters among the three type of over bite

1: Lower anterior facial height; 2: Interincisal angle; 3: Maxillary anterior alveolar and basal height; 4: Maxillary anterior alveolar depth; 5: Mandibular anterior alveolar and basal height; 6: Mandibular anterior alveolar depth

All variables were in millimeter except (IIA) in degree.

Different letters mean significant difference at 0.05 level.

Same letters mean no significant difference at 0.05 level.

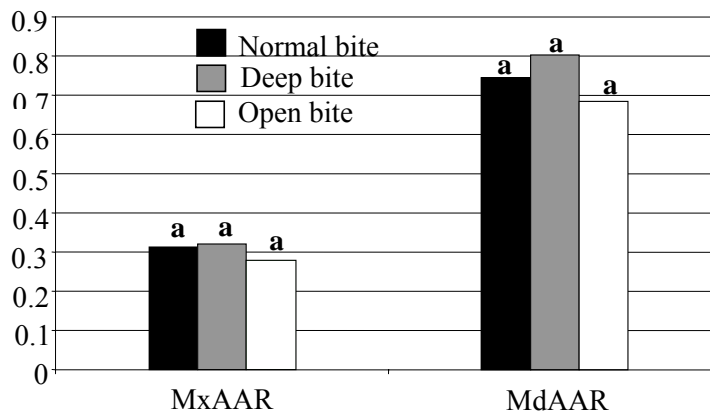


Figure (3): The differences in the values of the LAFH's component parameters among the three type of over bite

MxAAR: Maxillary anterior alveolar ratio; MdAAR: Mandibular anterior alveolar ratio.
All variables were in millimeter.
Same letters mean no significant difference at 0.05 level.

DISCUSSION

The insignificant gender's variation of all parameters except MxAAD, MxAAR and MdAABH in normal over bite group, as well as, in open bite group except IIA and in deep bite group except MdAAD indicated that these parameters were more stable in Class I dentoskeletal relationship and were not affected by the gender. This could be due to that parameters are strongly related to the same dentoalveolar and skeletal growth pattern of Class I dentoskeletal relationship. The insignificant gender's variation coincided with findings of the Beckermann *et al.*,⁽²⁰⁾ who reported the general pattern of differences of these parameters were gender independent. Other studies in normal over bite group demonstrated no gender variation in IIA,⁽²¹⁻²³⁾ whereas others reported no genders variation in LAFH.^(21, 24, 25) Contradictory studies were found significant gender variation in the LAFH⁽²⁴⁻²⁷⁾ and in IIA.⁽²⁴⁾

The significant gender variation in the MxAAD, MxAAR and MdAABH were appeared in the normal over bite. This disclose the property of normal over bite is relatively associated with greater mean value of these parameters in male than female, whereas the deep bite group showed significantly increase mean value in male than female in the MdAAD parameter, and the open bite revealed significantly increase mean value in male than female in IIA parameters. These variations could be due to compensatory growth changes in the de-

ntoalveolar components to approach the normal over bite relationship which was appeared more in male than female. This conclusion coincided with suggestion of other studies,^(28, 29) which reported that the alveolar structure plays role in establishing the vertical maxillomandibular relationships. Ismail and Barcin⁽²⁹⁾ reported that the MxAABH parameter was significantly gender variation in the over bite groups, whereas Beckermann *et al.*⁽²⁸⁾ did not find significant gender variation in the LAFH component parameters in over bite groups.

The over bite groups variation of the LAFH and its component parameters demonstrated that the open bite group was significantly increase of mean value at $p \leq 0.05$ in the LAFH and significantly decrease at $p \leq 0.05$ in IIA than the other over bite groups. This result obviously due to that open bite subject has increase in the LAFH and could change the incisor teeth inclination (decreasing the IIA). These results were confirmed with that of Beckermann *et al.*,^(20, 28) who reported that the LAFH had large correlation with over bite groups. Other studies⁽³⁰⁻³²⁾ disclosed that the open bite group characterized by long LAFH than deep bite group. Beckermann *et al.*⁽²⁸⁾ reported that the upper incisor was generally protruded in open bite group than normal over bite group, whereas in deep bite group the maxillary incisors was generally more inclined than normal over bite group. Meanwhile, the open bite group appeared insignificant mean value at $p > 0.05$ in

MxAABH, MxAAD, MxAAR, MdAABH, MdAAD and MdAAR when compared with the normal and deep bite groups. These results indicated that the compensatory growth of the alveolar structures of the LAFH was not statically affected by the changing the overbite. These findings were coincided with that of Beckermann *et al.*⁽²⁸⁾ regarding MxAAD, MdAAR. Other studies⁽³³⁻³⁵⁾ reported no significant differences in the anterior dentoalveolar height among the overbite groups, whereas Richardson⁽³⁶⁾ reported no abnormalities in anterior alveolar height between open bite and deep bite groups. The results were contradictory to the findings of Beckermann *et al.*⁽²⁸⁾ regarding the MxAABH, MdAABH, MdAAD and MxAAR. Other studies⁽³⁷⁻³⁹⁾ reported that the anterior dentoalveolar height was significantly greater in open bite group when compared with deep bite group in maxilla only.

The deep bite group disclosed no significant differences at $p > 0.05$ in the LAFH and its component parameters (LAFH, IIA, MxAABH, MxAAD, MxAAR, MdAABH, MdAAD and MdAAR) when compared with normal over bite group. This clearly indicated that the dentoskeletal structures of the lower facial height in deep bite patients were not statically influenced by the decreasing of the vertical incisal relation. These results came in accordance with that of Beckermann *et al.*⁽²⁸⁾ regarding MxAAD and MdAAR. Contrast findings have been demonstrated by some researchers. Beckermann *et al.*⁽²⁸⁾ revealed significant differences regarding the LAFH, IIA, MxAABH, MxAAR, MdAABH and MdAAD. Ismail and Barcin⁽²⁹⁾ found significant difference among the over bite groups concerning the MxAABH, MxAAR, MdAABH and the dentoalveolar height of the maxilla and mandible.

CONCLUSIONS

The conclusions of this study can be derived in that the significant gender variation of the LAFH and its components of the normal over bite group were appeared in MxAAD, MxAAR and mandibular anterior alveolar height. Whereas in deep bite group appeared in MdAAD, and in open bite group demonstrated in the IIA. The si-

gnificant variation of the LAFH and its components among the over bite groups were disclosed that the LAFH was significantly increase in open bite than the normal and deep bite groups. The IIA was shown significantly decrease in open bite group than the normal and deep bites groups.

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